Space Weather Technical Forecast

Issued on Saturday, 13 July 2024 at 01:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1s Likely throughout. G1/Minor geomagnetic storm intervals likely this weekend.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity as recorded at GOES16, was Low with frequent small C-class flares mainly emanating from the largest central sunspot group, AR3738. However, the largest flare of the period originated from AR3743, peaking at C6.5 at 12/1328 UTC. There are currently eight sunspot regions on the disc, with AR3738 in the southwest remaining the largest and most complex, with a Fki/beta-gamma classification. However, there are potentially some small and weak delta spots. The only other region of note is AR3743 in the southeast, which has continued to gradually develop, with the emergence of more intermediate spots and is now classified as Dsi/beta-gamma.
No Earth-directed Coronal Mass Ejections (CMEs) were observed in the period, with the main events in coronagraph imagery being CMEs from narrowly behind the western limb around the turn of the UTC day 11 into 12 July, and also a prominence eruption from the southeast around 12/0500UTC. Neither is expected to be Earth directed.

Solar Wind / Geomagnetic Activity: Slow solar wind conditions were observed at L1 by ACE. The solar wind speed was on average around 350km/s, peaking around 380 km/s. The solar wind density was unremarkable and below average, with typical single figures ppcc. The IMF remained weak, with a peak of 6nT and a north-south range of +/-5nT. The phi angle was predominantly negative (towards the Sun). The result of the solar wind measures was Quiet (Kp 0-2) geomagnetic conditions.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was predominantly at Normal Background levels. The 24-hour fluence was below Active, with a gradually declining trend and 1.78e6 integrated pfu observed at 13/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: M-class flares remain Likely, with AR3738 the most probable source. No significant regions are due to depart or arrive through the period.

Solar Wind /Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast. Initial slow wind conditions are expected to be followed by a slight enhancement due to the onset of the fast winds from CH52, these expected to arrive today (13th) and then persist for up to two days. The solar winds are expected to reach slightly elevated to temporarily elevated levels, around 500 km/s. Later in the period the solar wind is expected to decline to Background levels.

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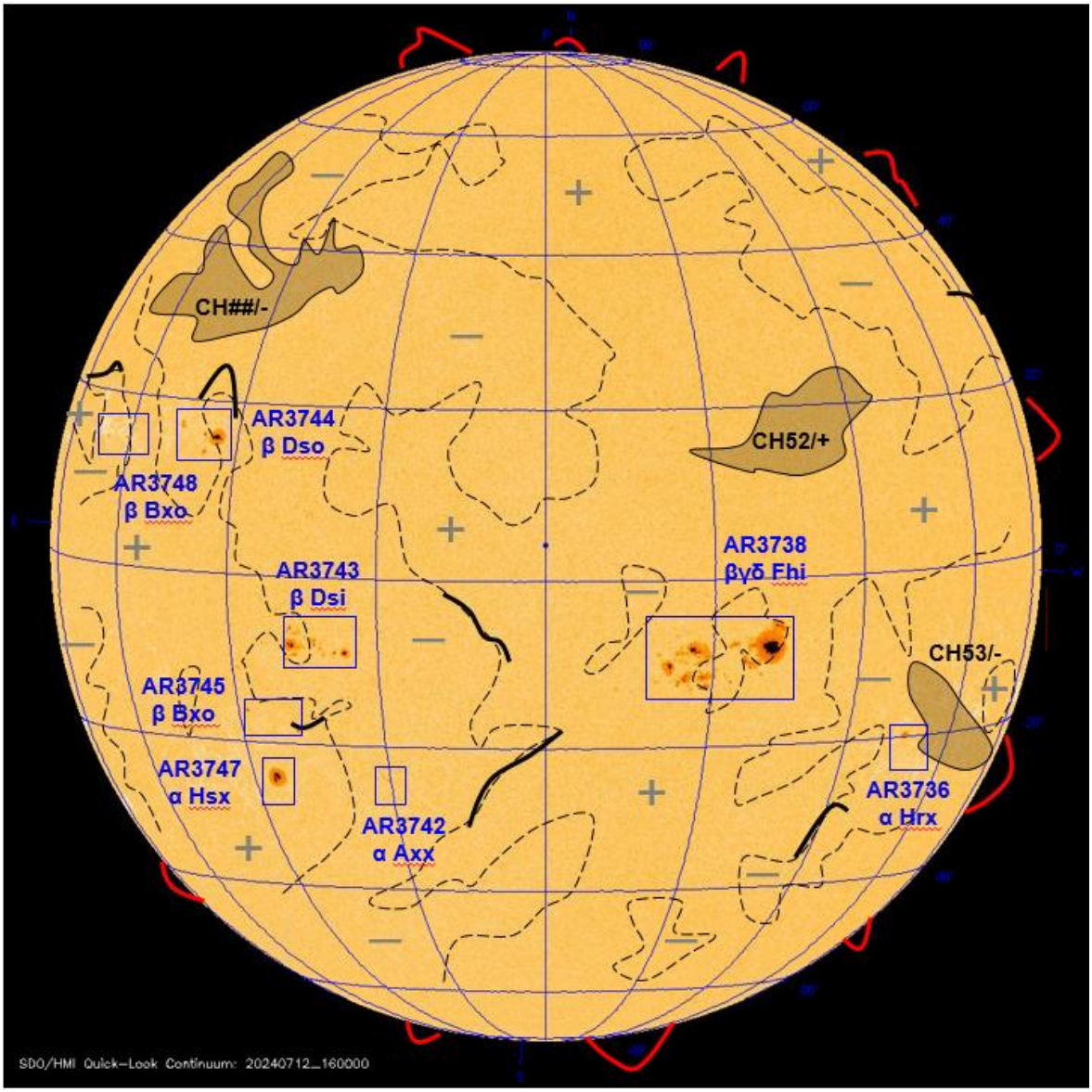
Met Office Space Weather Technical Forecast

Initially Quiet geomagnetic conditions are expected to increase to Active to G1/Minor geomagnetic storm levels (Kp 4-5) at times from later today into tomorrow, before reverting to Quiet to Unsettled (Kp 1-3) conditions into the new UTC working week.

Energetic Particles / Solar Radiation: High energy proton flux carries a daily Slight Chance of rising to exceed S1 in response to any notable flares from AR3738. This risk increases very slightly as this region progresses westwards in the period, with other regions contributing relatively little.
High energy electron flux is expected to remain mostly at Normal Background levels, but may respond to any fast wind enhancement, increasing to Moderate or perhaps temporarily peaking at High levels on days 3 and 4 (15 and 16 July). The associated 24-hour fluence is expected to remain below the Active level, but with a slightly increasing trend from tomorrow.

Figure 1. Solar Analysis Valid 12/1600 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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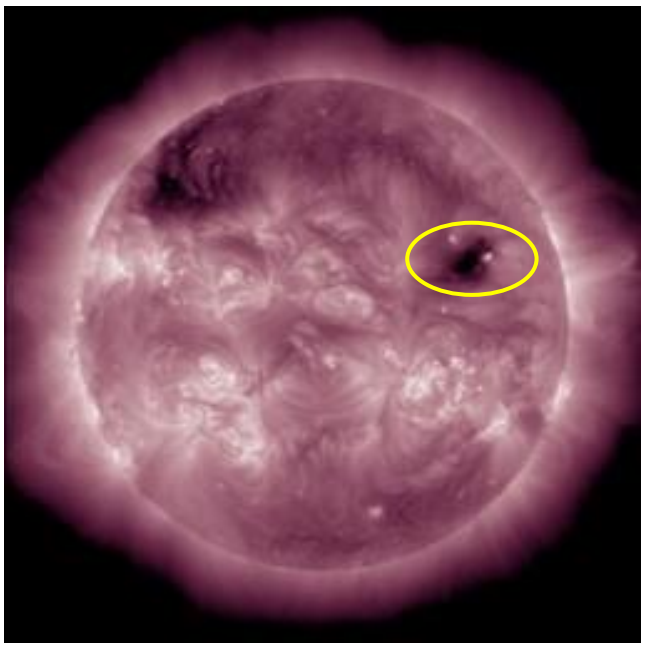
Geomagnetic Storms:

No CMEs feature in the current forecast.
Initial slow wind conditions are expected to be followed by a slight enhancement due to the onset of the fast winds from CH52, these expected to arrive around the middle of today (13th) and then persist for up to two days. CH52 is a broad positive hole in the northwest quadrant, and fast wind onset is more assured, likely peaking later today or early day 2 (14th). Enlil is currently providing poor guidance due to the over-estimation of a small southwestern coronal hole which did not connect with Earth, as Enlil indicates. Elevated winds are likely by the end of today into tomorrow (13-14 July), potentially increasing activity to Active to G1/Minor Geomagnetic Storm levels - a peak for the forecast period. Through day 3 (Monday 15 July) solar wind speeds are expected to gradually decline, probably back to Background levels, as geomagnetic activity also declines.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	50	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Latest SDO/AIA 211 image with CH52 in the northwest.



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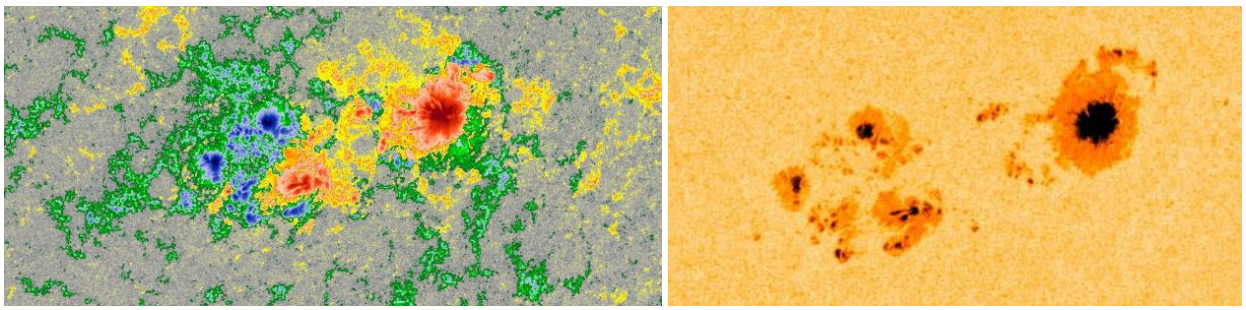
Radio Blackouts - X-Ray Flares:

There are currently eight regions on the disc, with a previous unnumbered region in the northeast quadrant now faded from view. By far the largest and most complex is AR3738, with potential weak delta spots. This region has recently expanded its penumbra on the main leading spot, changing its configuration to become more asymmetric. Also, some small faint trailing spots have developed, leading to its classification of Fki/beta-gamma with a 22 degree expanse. The other region of note is AR3743 in the east, which is now classified as Dsi/beta-gamma, and it was AR3743 which produced the largest flare of the previous 24 hours, despite AR3738's size and magnetic complexity. The remaining regions are all smaller, magnetically simpler and either stable or displaying smaller insignificant changes. No significant regions are due to depart or arrive through the period.
There is a chance of M-class flares, most probable from AR3738 due to its size and magnetic complexity, but also to a lesser extend from AR3743, with a Slight Chance of an isolated X-class flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Latest SDO/AIA images of AR3738 (magnetogram left and intensitygram right)



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at Background levels. It is most likely to remain at background levels, but with a slight chance of exceeding the S1/Minor radiation storm threshold should any significant flares occur, these perhaps most likely from AR3738. As this region rotates across the southwest quadrant, the probability of reaching S1 increases slightly.

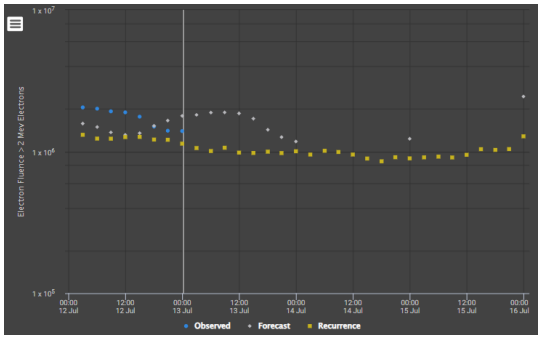
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux observed at GOES16 has been at predominantly Normal Background levels. Fast wind enhancements from coronal 52 are expected to occur today and tomorrow (13th and 14th), which may eventually increase electron populations at GEO. However, the scale of these enhancements is not expected to be large, and the onset of any upward trend in fluence will probably not occur immediately. MOSWOC REFM is producing good guidance, keeping the fluence well below the Active threshold (1e8 integrated flux) while indicating a slight rising trend later in the forecast period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	15
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Met Office REFM model.



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